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Nutritional and Economic Aspects of Fish and Seafood

Economic and Commercial Analysis Report n° 117

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Nutritional and Economic Aspects of Fish and Seafood

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EXECUTIVE SUMMARY

Canadian consumption of seafood is low compared to other sources of animal protein. The causes are numerous and, in many cases, related to the faulty perceptions of consumers. An analysis of the cost to consumers and the cost of protein for different foods reveals that, generally, fish compares favourably to many of them. Poultry is the only other source of animal protein that has an economic advantage over fish. However, an increased consumption of fish provides many health advantages. It is therefore a wise food choice with which consumers should become better acquainted.

SOMMAIRE EXÉCUTIF

La consommation canadienne de produits marins est plutôt faible comparativement aux autres sources de protéines animales. Les causes en sont multiples et, dans bien des cas, elles relèvent d'une mauvaise perception des consommateurs. L'analyse du prix de revient et du coût de la protéine de différents aliments démontre, de façon générale, que le poisson se compare avantageusement à plusieurs d'entre eux. Au niveau des protéines animales, seule la volaille possède un avantage économique sur le poisson. Cependant, une consommation accrue de poisson comporte plusieurs avantages pour la santé. C'est pourquoi les produits marins constituent un choix alimentaire judicieux que les consommateurs auraient avantage à mieux connaître.

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INTRODUCTION

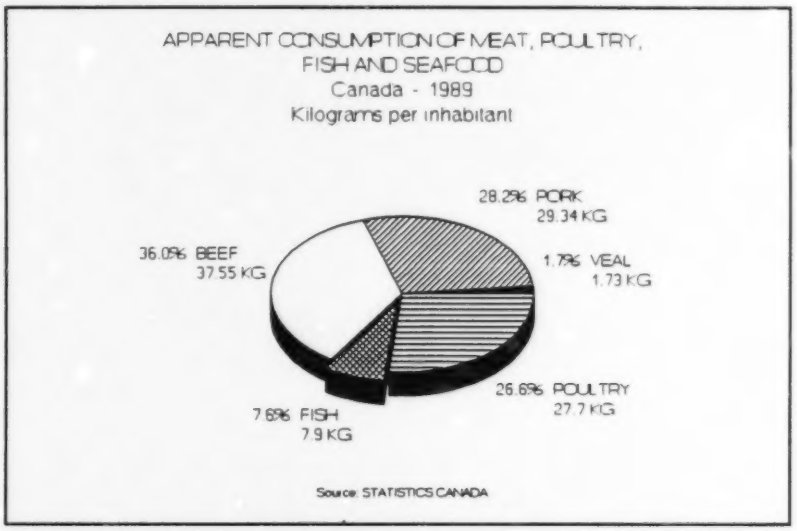
How many people know that there are 30,000 species of sea products in the world? Of course, they are not all to be found in Canada, but the range of products is sufficiently broad to bring variety to the table. Despite this, Canadians eat few marine products compared with people in some other countries. Consumption forecasts call for white meat, including fish and seafood, to become more popular, largely for health reasons. In this context, it is important that certain nutritional and economic aspects of fish be reviewed in greater depth.

First, Chapter 1 will describe how much fish and seafood Canadians eat, as well as addressing the psychological barriers restricting consumption. One of these, the shelf price of marine products, will be reviewed in greater depth in Chapter 2. The cost of protein will be used to compare the net cost price of sea products with, among others, that of meat and poultry. The following chapter will provide information on the nutritional aspects of fish and seafood. Finally, the health benefits of eating more marine products will be analysed.

CHAPTER 1: CONSUMPTION OF FISH AND SEAFOOD IN CANADA

1.1 Apparent consumption of meat, poultry, fish and seafood in Canada

Figure 1



Ichthyophagists, people whose diet consists mainly of sea products, are few and far between in Quebec. Indeed, in 1989, consumption of fish and seafood stood at 7.9 kilograms per person in Canada.[1] At the same time, the average Canadian ate 68.6 kilograms of red meat and 27.7 kilograms of poultry over the same period. Figure 1 provides a more detailed breakdown of these statistics. In fact, the nutritional contribution of fish to Canadians' diet is minimal considering that Canada ranks fifteenth in the world among producers of sea products.[2] According to a report on the nutritional aspects of eating fish,[3] protein, cholesterol, phosphorus and niacin from fish each accounted for a little more than 2 per cent of dietary intake. The same study reported that in 1986 meat, poultry and sea products provided 410 kilocalories of Canadians' daily diet, including approximately 40 grams of protein. Of this intake, 25 kilocalories, including 3.6 grams of protein, came from fish.

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1 Sources: Statistics Canada, Apparent per capita food consumption in Canada, Catalogues 32-229 and 32-230, 1990.

2 FAO, Fishery Statistics, Volume 68, 1989.

3 Fisheries and Oceans Canada, Economic and Commercial Analysis Directorate, Nutritional Aspects of Fish Consumption, 1988.

A particularity of this decade is a growing concern with health. In this spirit, the pursuit of a healthy diet is always with us. Trends point to growing popularity of white meat and seafood, but the fact remains that Canadians are fond of red meat. Perhaps they will opt for leaner cuts of beef rather than altering their old eating habits? Vigorous marketing efforts will have to be made to promote the consumption of fishery products, which offer attractive nutritional benefits.

1.2 Psychological barriers to eating fish and seafood

In the old days, sea products were rarely associated with periods of festivity. Having long been synonymous with abstinence and fasting, sea products then became something of a symbol of dieting. Nowadays they are valued, among others, by people concerned with their health. To the public, they represent an appropriate, socially acceptable choice. Despite this change, consumers put forward many arguments to explain why they eat so few sea products.

The freshness of marine products is often questioned by consumers. The highly perishable nature of these foods fuels this concern. Is there any animal product that advertises its freshness (or lack thereof) as clearly as fish? Not only can you see when it is not fresh, you can smell it! The older the product is, the more unpleasant its smell becomes as its components deteriorate. Conversely, a fresh product will have practically no smell, or may perhaps give off a subtle aroma of the sea. On the other hand, it is hard to tell how fresh red meat is. The components of meat products do, however, undergo deterioration. But this is less obvious, both to the nose and to the eye. And, as the saying goes, what you don't know doesn't hurt you.

The presence of fish bones often puts people off. This fear is increasingly easy to get round merely by choosing boneless sections, such as fillets, steaks and fish tails. And there are boneless sea products available on the market, in particular shellfish (molluscs and crustaceans) and a growing variety of secondary and tertiary processed products. In any case, the risk of choking is not limited to fish bones. After all, you can still choke on a chicken bone.

The presence of parasites in fish is another issue that concerns consumers. This is a natural phenomenon that is not caused by pollution. For fish fillets, "candling" them at the processing plant is sufficient to eliminate these parasites. This involves examining the fillets through a lighted slide and removing any parasites detected. Unfortunately some parasites may escape detection, and consumers rapidly develop a negative opinion of fish. It is important to emphasize that proper cooking and freezing render these parasites harmless. The real problem with these parasites is that they are visible to the naked eye. But *Escherichia coli (E. coli)*, which is prolific in meat, and salmonella in poultry are a greater threat to health. The fact that they are invisible to the eye lessens any potential concern from the consumer, though.

With the advent of environmental concerns, consumers have begun to question the quality of the water in which fish and shellfish live. Contaminants of all kinds have rapidly become topical issues. Studies show that certain populations practising subsistence (non-commercial) fishing, whose diet staple is fish, have had food poisoning. But the current level of Canadian consumption is not high enough for any concern whatsoever. Canadians could eat three times as many marine products without any danger to their health. Moreover, the Fisheries and Oceans Inspection Service closely monitors the commercial fishery. Areas where the concentration of pollutants exceeds the standards are closed to fishing. In this way, the Government ensures the safety of sea products.

The perception held by some consumers of the time it takes to prepare and cook fish is a disincentive to the consumption of sea products. Moreover, consumers often have the impression that these products are difficult to prepare. But, in fact, they are geared to the requirements of today. They may be bought in single portions, are prepared in the twinkling of an eye and take little time to cook. In addition, the wide range of forms (whole, fillet, steak, etc.) of products and species makes for variety. There is something here for everyone.

The cost of fish is sometimes why people do not eat more of it. There are those who claim that sea products are too expensive for their budget. Aside from seafood, some fish is more economical than most meat. Indeed, the next chapter provides a comparison of the real cost of meat, poultry, fish and seafood.

Overall, consumers' prejudices concerning sea products are gradually fading. The action already initiated by different industry players will help inform consumers more accurately about the qualities of fish.

CHAPTER 2: COST OF SELECTED FISH, SEAFOOD AND MEAT

Much of the population claims that cost prevents them from eating more sea products. But do consumers consider the fact that when they buy food they are also paying for the unusable parts, such as bone, fat, etc.? In short, this waste unquestionably raises the cost price of foodstuffs. For instance, a whole chicken will lose more than two-thirds of its original weight before it is served. When all is said and done, the shelf price of whole chicken is more than doubled.

2.1 Cost price

2.1.1 Methodology and concepts

Table 1 compares changes in the cost price of several foods, in April, from 1987 to 1991. This corresponds to the price paid by the consumer for an edible portion of 100 grams of food. Waste from food preparation (bone, skin and fat) and cooking were considered in the calculation. The details of this calculation are presented in Appendix 1.

Most of the retail prices in the first column of the table in Appendix 1 represent the average of prices in effect in six cities in the province for the first week of April each year. The data were gathered from Steinberg's, Provigo and Métro-Richelieu. The head offices of these food chains, located in the Montreal area, were contacted for the same information concerning sea products.

TABLE 1: Cost price[1] of selected meat, fish and shellfish per 100 grams of cooked food (1987-1991)

TYPE OF FOOD	1987	1988	1989	1990	1991
Sea products					
Frozen fillet of cod widely distributed brands	1.06	1.11	1.14	1.10	1.25
Fresh fillet of sole	2.15	2.18	1.74	1.76	1.76
Canned BC salmon 1st quality sockeye	1.98	2.06	2.72	2.11	2.00
Fresh shelled pink shrimp	N/A	N/A	2.38	2.13	1.56
Whole live lobster > 1 lb	5.26	5.17	5.91	4.61	5.17

[1] Price in April each year.

TABLE 1 (Cont'd)

TYPE OF FOOD	1987	1988	1989	1990	1991
Meat					
Fresh round of beef, Grade A or B, lean and fat	2.20	2.16	2.19	1.92	1.85
Veal escallop	2.64	2.62	2.79	2.76	2.76
Roast pork, boneless, dressed (shoulder)	1.56	1.59	1.34	1.59	1.31
Fresh or frozen chicken broiler or fryer, eviscerated, 1-2 kg, Grade A	0.70	0.72	0.85	0.96	0.78

TABLE 1 (Cont'd)

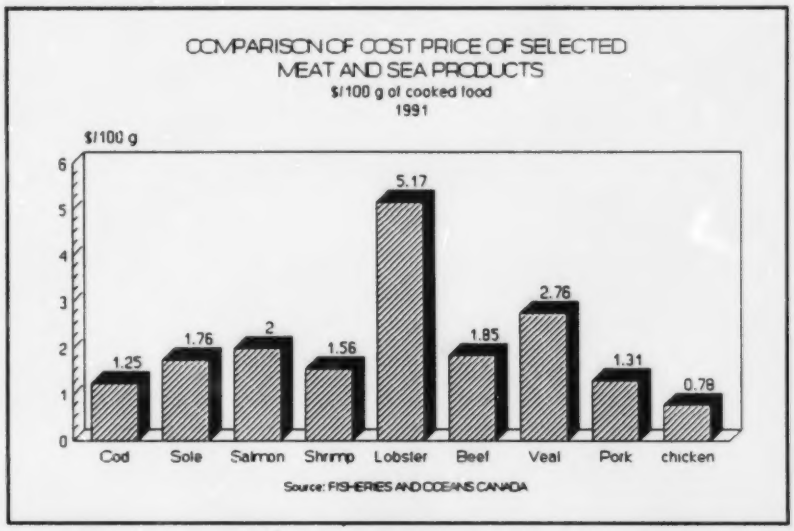
TYPE OF FOOD	1987	1988	1989	1990	1991
Other					
Large eggs Grade A	0.25	0.26	0.28	0.30	0.28
Cheese (sliced process cheese)	0.82	0.92	0.94	0.95	1.00
Peanut butter	0.46	0.46	0.47	0.48	0.59
Baked beans with pork and tomato sauce	0.32	0.29	0.25	0.30	0.30

Source: Economic Services Division, DFO, Quebec Region

2.1.2 Discussion

Among fish and shellfish, cod in fillet form is the most economical to eat.

Figure 2



In 1991, 100 grams of cooked fillet of cod cost $1.25. This is even cheaper than buying an equivalent amount of beef, veal or pork, despite the falling retail price of beef. Shelled shrimp, contrary to popular belief, is a highly affordable seafood, or at least has been over the past few years. While it may appear expensive at first glance, it must be borne in mind that in this form there is no waste. In addition, fresh fillet of sole and canned salmon are also wise choices, since their cost compares favourably to that of beef and veal escallop. Lobster remains a luxury product, particularly outside the fishing season. Last April, 100 grams of lobster meat cost $5.17.

2.2 Cost of protein

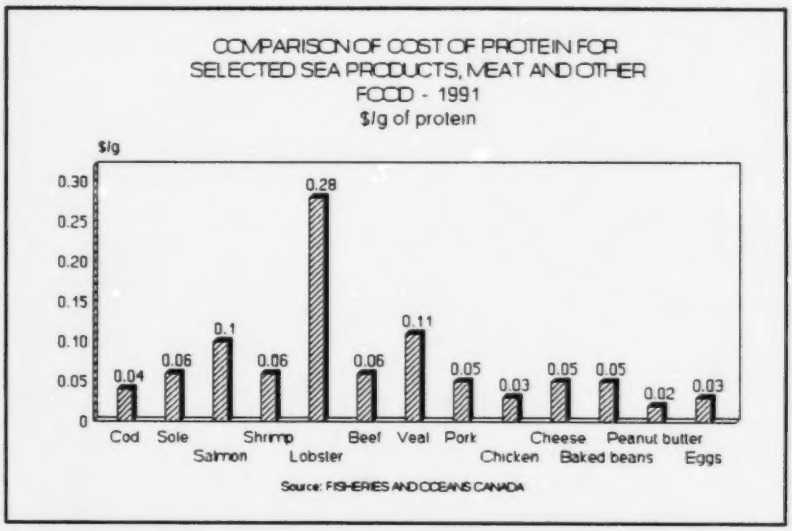
2.2.1 Methodology and concepts

The cost of protein expressed in Table 2 is intended as an indicator to show the consumer what it costs to supply an individual with one gram of protein. Individuals' daily protein requirements were updated in 1990 by the scientific review committee charged with Canadian recommendations on nutrition. It was established that a man aged between 25 and 49 practising a moderate level of activity would have his daily requirements met if he consumed 78 grams of protein. For a woman with the same characteristics, 68 grams of protein would supply the recommended quantities of essential nutrients. In other words, the cost appearing in Table 2 must be multiplied by the quantity of protein, specific to each individual, to estimate what it would cost an individual daily to meet his protein requirements.

The cost of protein corresponds to the result of dividing the cost price for 100 grams of cooked food by the protein content of the same quantity of food (see detailed calculations in Appendix 2). The cost price of a food product may seem absurdly low, but its protein content still has to be high to make any savings.

2.2.2 Discussion

Figure 3



While the cost price of baked beans seems extremely cheap, its low protein content explains why a fillet of cod supplies protein that costs less than this pulse. Moreover, fish in general represents an important source of protein, much like meat and poultry. Of the meat, poultry and marine products compared, chicken is the food with the most economical protein. But fish, generally speaking, is as affordable a source of protein as meat (see Figure 3). Once again, lobster is an expensive item.

TABLE 2: Cost of protein[1] from selected meat, fish and shellfish (1987-1991)

TYPE OF FOOD	1987	1988	1989	1990	1991
Sea products					
Frozen fillet of cod widely distributed brands	0.04	0.04	0.04	0.04	0.04
Fresh fillet of sole	0.07	0.07	0.06	0.06	0.06
Canned BC salmon 1st quality sockeye	0.10	0.10	0.13	0.10	0.10
Fresh shelled pink shrimp	N/A	N/A	0.10	0.09	0.06
Whole live lobster > 1 lb	0.28	0.28	0.31	0.25	0.28

[1] Price in April each year.

TABLE 2 (Cont'd)

TYPE OF FOOD	1987	1988	1989	1990	1991
Meat					
Fresh round of beef, Grade A or B, lean and fat	0.08	0.08	0.08	0.07	0.06
Veal escallop	0.10	0.10	0.11	0.11	0.11
Roast pork, boneless, dressed (shoulder)	0.06	0.06	0.05	0.06	0.05
Fresh or frozen chicken broiler or fryer, eviscerated, 1-2 kg, Grade A	0.02	0.02	0.03	0.03	0.03

TABLE 2 (Cont'd)

TYPE OF FOOD	1987	1988	1989	1990	1991
Other Large eggs Grade A	0.02	0.02	0.03	0.03	0.03
Cheese (sliced process cheese)	0.04	0.05	0.05	0.05	0.05
Peanut butter	0.02	0.02	0.02	0.02	0.02
Baked beans with pork and tomato sauce	0.05	0.05	0.04	0.05	0.05

Source: Economic Services Division, DFO, Quebec Region.

In short, the cost of protein is an additional notion for informing people how accessible sea product prices are.

In future, consumers will have to find some other reason besides excessive cost for not eating more fish. Generally speaking, the percentage of waste for sea products is lower than for meat products. This factor is worth bearing in mind when buying food, since it considerably alters the purchase price of the product. In addition, given the wide range of sea products on the market, consumers will surely be able to find a species that suits their wallet.

CHAPTER 3: NUTRITIONAL COMPOSITION OF FISH AND SHELLFISH

3.1 Nutritional characteristics

3.1.1 Proteins

Proteins are an indispensable part of the human diet. They perform their own special functions. Among other things, they look after making, maintaining and repairing tissue. They regulate muscle contraction and ensure that several substances, in particular oxygen, are transported through the body. They also affect the immune system.

Several categories of food contain proteins. They are to be found particularly in meats and substitutes, marine products, dairy products, bread and cereals.

It is recommended that proteins supply 15 per cent of Canadian food intake.[1]

It may be seen from Table 3 that fish and shellfish are an excellent source of proteins, whose content compares favourably to that of meat and poultry. Sole even stands out from the sample owing to its high protein level. Moreover, proteins from sea products are of high quality.

In the human diet, the quality of proteins depends on their digestibility and the arrangement of the amino acids which compose them. Proteins from eggs, milk, meat, poultry and fish are of high quality on both counts. On the other hand, vegetable proteins, such as those contained in pulses, are incomplete. In fact, certain amino acids essential for the synthesis of proteins by the body are missing. Furthermore, as may be seen from Table 3, plants and vegetables contain on average one-third the proteins of food of animal origin.

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[1] Health and Welfare Canada. Nutrition Recommendations. Report of the Scientific Review Committee, 1990. Ottawa, 1990.

TABLE 3: Protein content of meat, poultry, fish, shellfish and selected pulses per 100 grams of cooked food

FOOD (100 g)	PROTEIN (g)
Fish:	
Grilled cod	28.5
Baked sole	30.0
Fried ocean perch	19.0
Grilled halibut	25.2
Fried haddock	19.6
Canned pink salmon	20.5
Shellfish:	
Canned shrimp	24.2
Steamed lobster	18.7
Steamed crab	17.3
Steamed scallops	23.2
Meat:	
Lean minced beef	27.4
Lean sliced ham	19.4
Lean and fat veal	27.2
Broiler chicken, meat only	27.0
Pulses:	
Red kidney beans	7.8
Cooked lentils	7.8
Baked beans and canned tomatoes	6.1

Source: Dubuc and Lahaie, Valeur nutritive des aliments (Nutritional value of food), 1987.

3.1.2 Lipids or fats

The fat content of fish varies considerably from one species to another. The values shown in Table 4 indicate the discrepancy that may exist among species. Fat content is less than 2 per cent for lean sea products and reaches at least eight 8 per cent for fatty marine products. The season also affects the percentage of lipids, particularly among fattier species such as herring, mackerel and salmon. Similarly, the rearing technique used affects the fish's fat level. Generally speaking, fish from aquaculture are richer than those from a natural environment (Higgs et al, 1989).[1]

R.G. Ackman, a professor of food science and researcher with the Canadian Institute of Fisheries Technology in Nova Scotia, has proposed a fish and seafood classification based on their lipid content (see Table 4). Such a classification system is an invaluable tool for helping consumers make informed choices.

3.1.2.1 Omega-3 (n-3) fatty acids

Food fats are made up of different sorts of fatty acids, which may be classified according to their degree of unsaturation. Indeed, that is why they are called monounsaturated, polyunsaturated or saturated fatty acids.

Polyunsaturated fats are the main fatty acids in fish, where they are more abundant than in meat. Fish meat also contains fewer saturated fats than products of animal origin. A decrease in intake of saturated fats is one of the new recommendations on nutrition issued by Health and Welfare Canada in 1987. According to the committee, in addition to providing only 30 per cent of the total quantity of energy in lipid form, Canadians' diet should include a maximum intake of 10 per cent of saturated fats. While total fat intake is of considerable importance, the nature of the

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[1] Fisheries and Oceans Canada, Economic and Commercial Analysis Directorate, Nutritional Aspects of Fish Consumption, 1988.

fatty acids is more so. Thus, a reduction in saturated fats would help bring down the level of cholesterol in the blood and reduce the risk of heart disease. In this regard, eating fish deserves to be encouraged.

The family of polyunsaturated fats includes a group of fatty acids called omega-3, whose chemical structure is particular. Fatty sea products are the food source with the highest concentrations of the omega-3 series (eicosapentaenoic acid (EPA) and docosahexanoic acid (DHA)). These fatty acids present in fish come from the zooplankton they ingest.

The fatty acid composition of fish has elicited a great deal of interest in recent years. This marked attention stems from the conclusions of studies which have established a link between the type and quantity of food fatty acids and cardiovascular disease. The next chapter is devoted to the health benefits which relatively high consumption of sea products can yield.

TABLE 4: Classification of fish and shellfish by fat content

CATEGORY	% OF FAT	EXAMPLES OF SPECIES
Lean	< 2	cod, haddock, hake, lobster, scallops, shrimp, crab
Low fat	2-4	sole, tuna, halibut, mussels, oysters
Medium fat	4-8	salmon, swordfish, turbot
High fat	> 8	herring, mackerel

Sources: Ackman R.G., Seafood fats in nutrition, Progress Food Nutrition Science, 1989.

Ackman R.G., Seafood lipids and fatty acids, Food Reviews International, 1990.

3.1.2.2 Cholesterol

In comparison with meat and poultry, cholesterol levels in fish and molluscs are slightly lower. Aside from lobster, crustaceans are an exception, since their cholesterol content is slightly above that of animal products. Table 5 presents the cholesterol content of these foods.

Generally speaking, industrialized countries show high cholesterol intake and also have the highest prevalence of coronary disease. In Canada, the average cholesterol intake is currently between 400 and 600 milligrams per day. In light of these observations, the Consensus Conference on Cholesterol advocates reducing ingestion of cholesterol to 300 milligrams per day. With the exception of shrimp, increasing the proportion of sea products in Canadians' diet would be an effective means of reducing our cholesterol consumption.

TABLE 5: Cholesterol content of meat, poultry, fish and shellfish per 100 grams of cooked food

FOOD (100 g)	CHOLESTEROL CONTENT (mg)
Fish:	
Grilled cod	81
Baked sole	90
Fried ocean perch	58
Grilled halibut	64
Fried haddock	35
Canned pink salmon	94
Shellfish (molluscs):	
Canned oysters	45
Steamed scallops	53
Canned mussels	45
Shellfish (crustaceans):	
Steamed crab	100
Steamed lobster	85
Canned shrimp	150
Meat:	
Lean minced meat	94
Braised lean and fat pork shoulder	109
Lean and fat veal	101
Broiler chicken, meat only	94
Other:	
Eggs	548
Process cheese	64
Peanut butter	0
Baked beans, tomato sauce	4

Source: Dubuc and Lahaie, Valeur nutritive des aliments (Nutritional value of food), 1987.

3.1.3 Energy content

The energy value of a food is calculated from its protein, fat and sugar content. Since lipids have a higher caloric value (9 kilocalories per gram) than proteins and sugars (4 kilocalories per gram), high fat sea products will have a higher energy value than leaner sea products. While these foods are generally low-calorie, cooking and preparation often change the picture.

According to the Food and Agriculture Organization (FAO), the World Health Organization (WHO) and the United Nations University (UNU), an individual's energy requirements are defined as the quantity of energy necessary to preserve health, ensure growth and enjoy an appropriate level of physical activity.[1] These requirements vary with age, sex, weight and level of physical activity. For instance, a man aged between 25 and 49, practising an average level of activity and weighing approximately 66 kilograms, will have his daily energy requirements met by 2,900 kilocalories. Similarly, it is estimated that the energy requirements of a woman from the same age group, exercising the same level of activity, will be 2,200 kilocalories per day if she weighs approximately 58 kilograms.

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[1] Health and Welfare Canada. Recommendations on Nutrition. Report of the 1990 Scientific Review Committee, Ottawa, 1990.

Table 6 refers to notions already covered in the first two chapters. It subdivides foods into three categories according to the cost of protein. The food products are also analysed in nutritional terms (cholesterol and energy value).

Of the foods compared, peanut butter ranks a clear first. The proteins contained in this product are the most economical, although they are of lesser quality owing to their vegetable nature. Cholesterol-free, peanut butter nonetheless remains a very high energy food, so its consumption should be meted out with care. Of all sources of animal protein, chicken is without doubt the most judicious choice, in both economic and health terms. Also, for people with no cholesterol problems, eggs are a good buy.

Table 6 shows that several sea products are equivalent to and even surpass the other foods in terms of cost and nutritional benefits. Thus, shoulder of pork is outstripped by fillet of cod. Compared with pork, the protein in cod is less costly, this fish contains less cholesterol and its energy value is lower. For its part, the fillet of sole stands out owing to its low energy value, in addition to the cost of its protein, which is similar to that of beef. From the economic point of view, shelled shrimp ranks alongside beef and sole. But care must be taken concerning the high cholesterol content of shrimp. Canned salmon, despite the higher cost of its protein, is a very good food choice. Finally, lobster remains a luxury crustacean, but offers attractive health-related properties.

Fish is a nutritional food which adds variety to our menus. Eating more sea products is in line with Canadian nutrition recommendations.

TABLE 6

BUYING GUIDE:

COST AND NUTRITIONAL INFORMATION PER 100 GRAMS OF COOKED FOOD

TYPE OF FOOD (100 g OF COOKED FOOD)	COST PRICE ($/100 g)	COST OF PROTEIN ($/100 g)	CHOLESTEROL (mg/100 g)	ENERGY VALUE (kcal/100 g)
EXCELLENT CHOICE				
1. Peanut butter[1]	0.59	0.02	-	591
2. Eviscerated whole chicken[2]	0.78	0.03	94	167
3. Eggs (boiled)[3]	0.28	0.03	548	158
4. Frozen fillet of cod[2]	1.25	0.04	81	105
5. Baked beans in tomato sauce[4]	0.30	0.05	4	122
6. Pork shoulder[2]	1.31	0.05	109	166
7. Process cheese[5]	1.00	0.05	64	328

TABLE 6 (Cont'd)

TYPE OF FOOD (100 g OF COOKED FOOD)	COST PRICE ($/100 g)	COST OF PROTEIN ($/100 g)	CHOLESTEROL (mg/100 g)	ENERGY VALUE (kcal/100 g)
VERY GOOD CHOICE				
8. Fillet of sole[2]	1.76	0.06	90	91
9. Fresh round of beef[2]	1.85	0.06	94	185
10. Shelled shrimp[2]	1.56	0.06	150	116
11. Canned salmon[2]	2.00	0.10	94	163
GOOD CHOICE				
12. Veal escallop[2]	2.76	0.11	101	216
13. Whole lobster > 1 lb[2]	5.17	0.28	85	98

Equivalents:

1. 100 g of peanut butter = 7 tablespoons
2. 100 g of meat, poultry, fish or shellfish = 3½ ounces
3. 100 g of eggs = 2 large eggs
4. 100 g of baked beans = more than 1/3 cup
5. 100 g of cheese = 3 individually packed slices (e.g., "Singles")

Source: Economic Services Division, DFO, Quebec Region

CHAPTER 4: HEALTH BENEFITS OF EATING SEA PRODUCTS

4.1 Cardiovascular disease

The Quebec Heart Foundation estimates that of 100 Canadian deaths in 1990, 44 were from cardiovascular disease. Indeed, this disease is the leading cause of death in the country. Sex, heredity, age and smoking activity are all factors which increase the risks of eventually contracting this disease. Diet is another risk factor which greatly affects its incidence. The quantity and quality of fats ingested (saturated versus unsaturated fatty acids) as well as cholesterol are various aspects of the diet involved.

The relationship between high blood cholesterol levels and predisposition to coronary disease has been established for some years now. A high level of cholesterol in the blood is explained, among other things, by the presence of a substantial quantity of specific lipoproteins (low density lipoproteins, or LDL). These proteins carry cholesterol to the liver from the blood vessels. The cholesterol is thus discharged into the bloodstream. It is deposited on the artery walls and, over time, narrows the diameter of the arteries. Blood circulation then becomes more difficult, demanding additional effort from the heart. Eventually, the cardiac muscle tires. That is when cardiovascular complications can arise. The route travelled by the LDL justifies the name of "bad cholesterol" that is often given to them.

At the same time, high density lipoproteins (HDL) are also used by cholesterol for locomotion. But, unlike LDL, HDL collects the platelets of cholesterol clinging to the arteries and returns them to the liver, which eliminates them in bile. The purifying role of HDL explains why these lipoproteins are better known as "good cholesterol".

Studies maintain that a high dietary intake of saturated fatty acids would lead to an increase in the level of cholesterol in the blood, which in its turn, would heighten the risk of cardiovascular ailments (Stallones, 1983). Following a survey of Canadians' eating habits, nutrition experts strongly recommend restricting the intake of meat, a notable source of saturated fatty acids. In this way, they hope to see the mortality rate of cardiovascular disease reduced.

Research also tends to show that the consumption of polyunsaturated fatty acids is associated with a drop in the blood cholesterol level (Keys et al, 1965). **Remember, sea products are an abundant source of this type of fatty acids.**

Over the past few years, experiments have made it possible to explore the relationship between the consumption of sea products and the modification of blood lipids. This variation in blood profile reduces the number of deaths from cardiac disease. The protective effect of fish on cardiopathy is largely attributable to the presence of omega-3 fatty acids, EPA and DHA, concentrated in sea products. A number of researchers have pointed out that this type of fat leads to a decrease in serum lipids and lowers the concentration of LDL. Other short-term tests carried out on humans have highlighted a significant increase in HDL following a relatively high intake of omega-3 fatty acids. According to a U.S. study conducted last year, a daily intake of one-half to one gram of omega-3 fatty acids is sufficient to reduce the risk of suffering a cardiovascular disease by 40 per cent. During this experiment, the Americans' menu consisted primarily of sea products. Considering that the average omega-3 fatty acid content of fish and seafood is 0.005 per cent by weight, the subjects under study ate from 100 to 200 grams of fishery products per day.

A study carried out in England in 1990 cites the case of heart attack survivors who prolonged their lives after regularly introducing fish into their menus two or three times a week. Patients who had suffered similar troubles but had not altered their eating habits died earlier than the first group.

This marked interest in fish arose when it was pointed out that populations fond of

marine mammals or fish posted low levels of cardiovascular disease. Among the Inuit of Greenland, who regularly eat substantial quantities of fat from marine mammals, cardiac disease is rare (Bang and Dyerberg, 1980). A similar phenomenon may be seen in Japan. In 1989, the individual Japanese ate up to 219 grams of sea products per day (Infofish International).

Furthermore, a study conducted in 1990 on a group of fishermen and their families living on the Lower North Shore of the Gulf of St. Lawrence[1] showed that organochlorinated compound (PCB and DDT) and mercury blood levels were high. These results may be attributed partly to substantial consumption of sea products, but primarily to the consumption of marine bird eggs. Indeed, the latter are 45 times more contaminated than fishery products. Another factor to be borne in mind is that the population under study ate seven times as many sea products as the Canadian average.

Not all studies confirm the relationship between eating marine products and cardiopathy. In a huge research project on Norwegians, no link was observed (Vollset et al, 1985). In Canada, mortality rates associated with cardiovascular disease are higher in the Atlantic Provinces, where consumption is higher than on the Prairies. These contradictory results may be explained by the fact that other risk factors are not considered, and by the overall influence of diet. One may also wonder whether current consumption of sea products is sufficient to have any effect whatsoever on the health of the heart and arteries. On the other hand, it would seem appropriate to limit consumption of salted, marinated and smoked fish in order to reduce the risk of high blood pressure and cancer of the stomach.[1]

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[1] Dewailly E., Laliberté C., Gingras S. and P. Ayotte, Environmental health unit, Community health department, CHUL (Laval University hospital centre). Consommation des produits de la mer sur la Basse-Côte-Nord, 1991. Golfe Saint-Laurent: Risques et bénéfices pour la santé (Consumption of sea products on the Lower North Shore, 1991. Gulf of St. Lawrence: Health risks and benefits).

[1] National Institute of Nutrition, Le poisson dans l'alimentation des Canadiens (Fish in Canadians' diet). Le point I.N.N., January 1991.

Despite the diverging conclusions, most studies maintain that eating fishery products two or three times a week may help lower the risk of cardiopathy. Generally speaking, increased consumption of sea products leads to a decrease in serum lipids and LDL.

If each adult (aged 15 and over) in Canada ate fish twice a week, consumption of sea products could be estimated at 14.4 kilograms per capita.[2] At the rate of three meals a week, this would rise to 21.6 kilograms per inhabitant. With apparent per-capita consumption of 7.87 kilograms of sea products in 1989,[3] we have a long way to go yet.

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[2] In 1990, 21.03 million Canadians were aged 15 and over (out of a total population of 26.6 million).

[3] Statistics Canada. Apparent per capita food consumption in Canada. Ottawa, Cat. 32-229 and 32-230, 1990.

4.2 Obesity

According to Health and Welfare Canada, 27 per cent of Canadians were overweight or obese in 1988. An excess of adipose tissue may lead to other complications, such as coronary disease, high blood pressure, diabetes, and so on.

The maintenance of body weight depends upon the balance of two variables: energy intake and energy expenditure. When the calories ingested exceed those burnt, theoretically there is a weight increase, and vice versa. Moderate physical activity and a varied, balanced diet are preventive measures against obesity.

The data in Table 7 illustrate the low energy value of lean fish compared with lean meat and poultry. Cod, lobster, oysters and halibut, in short, all sea products whose fat content is not more than 2 per cent (see Ackman's proposed classification in Chapter 2) supply between 100 and 140 kilocalories per 100 grams of cooked food. By comparison, roast chicken or any other lean meat, for an equivalent quantity of food, contain more calories. Even fattier species such as salmon and herring have an energy value that compares favourably to lean beef.

TABLE 7: Energy value of selected fish and shellfish per 100 grams of cooked food

FOOD (100 g)	ENERGY VALUE (kcal)
Steamed lobster	98
Baked cod	105
Steamed oysters	137
Baked halibut	140
Canned Keta salmon	163
Baked herring	203
Canned shrimp	116
Lean ham, roasted	157
Roast fillet of pork	166
Roast chicken, meat only	167
Beef sirloin, lean, grilled	185
Lean stewing beef, shoulder, cooked on low heat	226
Boiled eggs	158
Process cheese	328
Peanut butter	591
Baked beans	122

Sources: Health and Welfare Canada, Canadian Nutrient File, 1988.

U.S. Department of Agriculture, Composition of Foods: Finfish and Shellfish Products, 1987.

Vanderstoep et al., Canadian Institute of Food Science and Technology Journal, at press.

In short, from a weight control perspective, lean sea products are a valuable source of food, owing to their relatively low energy value.

"Eat fish, it'll help your brain cells grow"

Who has not heard their grandmother praising the beneficial effect of fish on intelligence? This old saying has a solid scientific basis. In fact, researchers recently discovered that omega-3 fatty acids play an important role in the development of the neural tissue of the brain. They are also involved in the formation of the retina. These are all benefits to be added to the list for persuading consumers to make fish a regular item on their menu.

Conclusion

For over 20 years, numerous agencies have drawn up food guidelines for the public with a view to reducing the risks of cardiovascular disease and obesity. While these may differ from one country to another, they have much in common and, among other things, target reduced intake of fat and saturated fatty acids.

At the present time, the energy intake of the average Canadian's diet consists of 38 per cent lipids, while saturated fatty acids account for 14 per cent (Agriculture Canada, 1988 and 1989). The experts agree in recommending a total fat intake comprising 30 per cent of the energy consumed, including 10 per cent in the form of saturated fatty acids. Consequently, it is recommended that consumption of lipid-rich and saturated fatty acid-rich foods be reduced. Eating more sea products is in line with these recommendations, since several species have low fat content. In addition, compared with meat and poultry, sea products have low levels of saturated fatty acids. Also, for those wishing to watch their weight, sea products are a food of choice.

The conclusions of studies remain uncertain concerning the specific health benefits that may be offered by regular, moderate consumption of sea products. But most of these studies suggest that eating sea products two or three times a week may be an effective preventive method for at least restricting cardiovascular disease.

APPENDICES

APPENDIX 1: **Detailed calculation of cost price[1] of selected meat, fish and shellfish per 100 gra of cooked food (1987-1991)**

TYPE OF FOOD	AVERAGE RETAIL PRICE[2] ($/100 g)	% WASTE (BONE, SKIN, FAT) [3]	COST PRICE PER EDIBLE PORTION ($/100 g)	% WASTE IN COOKING[3]	COST PRICE PER COOKED PORTION ($/100 g)
Sea products					
Frozen fillet of cod, widely distributed brands	1987: 0.85 1988: 0.88 1989: 0.91 1990: 0.87 1991: 1.00	4	0.88 0.92 0.95 0.91 1.04	17 (with cover)	1.06 1.11 1.14 1.10 1.25
Fresh fillet of sole	1987: 1.96 1988: 1.98 1989: 1.58 1990: 1.60 1991: 1.60	-	1.96 1.98 1.58 1.60 1.60	9 (baked)	2.15 2.18 1.74 1.76 1.76
Canned BC salmon, 1st quality sockeye	1987: 1.60 1988: 1.67 1989: 2.20 1990: 1.71 1991: 1.62	19	1.98 2.06 2.72 2.11 2.00	-	1.98 2.06 2.72 2.11 2.00
Fresh shelled pink shrimp	1987: N/A 1988: N/A 1989: 2.38 1990: 2.13 1991: 1.56	-	N/A N/A 2.38 2.13 1.56	-	N/A N/A 2.38 2.13 1.56
Live whole lobster > 1 lb	1987: 1.21 1988: 1.19 1989: 1.36 1990: 1.06 1991: 1.19	67	5.26 5.17 5.91 4.61 5.17	-	5.26 5.17 5.91 4.61 5.17

APPENDIX 1 (Cont'd)

TYPE OF FOOD	AVERAGE RETAIL PRICE[2] ($/100 g)	% WASTE (BONE, SKIN, FAT) [3]	COST PRICE PER EDIBLE PORTION ($/100 g)	% WASTE IN COOKING[3]	COST PRICE PER COOKED PORTION ($/100 g)
Meat					
Fresh round of beef, Grade A or B, lean and fat	1987: 1.24 1988: 1.21 1989: 1.23 1990: 1.08 1991: 1.04	12	1.41 1.38 1.40 1.23 1.18	36 (braised)	2.20 2.16 2.19 1.92 1.85
Veal escallop	1987: 1.69 1988: 1.67 1989: 1.79 1990: 1.76 1991: 1.76	18	2.06 2.04 2.18 2.15 2.15	22	2.64 2.62 2.79 2.76 2.76
Roast pork, boneless, dressed (shoulder)	1987: 0.56 1988: 0.57 1989: 0.48 1990: 0.57 1991: 0.56	37	1.06 1.08 0.91 1.08 0.89	32	1.56 1.59 1.34 1.59 1.31
Fresh or frozen chicken broiler or fryer, eviscerated, 1-2 kg, Grade A	1987: 0.32 1988: 0.33 1989: 0.39 1990: 0.44 1991: 0.36	38	0.52 0.53 0.63 0.71 0.58	26	0.70 0.72 0.85 0.96 0.78

APPENDIX 1 (Cont'd)

TYPE OF FOOD	AVERAGE RETAIL PRICE[2] ($/100 g)	% WASTE (BONE, SKIN, FAT) [3]	COST PRICE PER EDIBLE PORTION ($/100 g)	% WASTE IN COOKING[3]	COST PRICE PER COOKED PORTION ($/100 g)
Other					
Large eggs Grade A	1987: 0.22 1988: 0.23 1989: 0.25 1990: 0.26 1991: 0.25	12	0.25 0.26 0.28 0.30 0.28	-	0.25 0.26 0.28 0.30 0.28
Cheese (Sliced process cheese)	1987: 0.82 1988: 0.92 1989: 0.94 1990: 0.95 1991: 1.00	-	0.82 0.92 0.94 0.95 1.00	-	0.82 0.92 0.94 0.95 1.00
Peanut butter	1987: 0.46 1988: 0.46 1989: 0.47 1990: 0.48 1991: 0.59	-	0.46 0.46 0.47 0.48 0.59	-	0.46 0.46 0.47 0.48 0.59
Baked beans with pork and tomato sauce	1987: 0.32 1988: 0.29 1989: 0.25 1990: 0.30 1991: 0.30	-	0.32 0.29 0.25 0.30 0.30	-	0.32 0.29 0.25 0.30 0.30

Sources:

(1) Prices in April each year.

(2) Statistics Canada, Consumer Prices and Price Indexes April-June 1987-1991, Catalogue 62-010.

(3) U.S. Department of Agriculture, Food Yields Summarized by Different Stages of Preparation, Handbook No. 102, 1975.

APPENDIX 2: Detailed calculation of cost of protein[1] from selected meat, fish and shellfish (1987-1991)

TYPE OF FOOD	COST PRICE PER COOKED PORTION[2] ($/100 g)	PROTEIN CONTENT (g/100g)[3]	COST OF PROTEIN ($/g)
Sea products			
Frozen fillet of cod, widely distributed brands	1987: 1.06 1988: 1.11 1989: 1.14 1990: 1.10 1991: 1.25	28.5	0.04 0.04 0.04 0.04 0.04
Fresh fillet of sole	1987: 2.15 1988: 2.18 1989: 1.74 1990: 1.76 1991: 1.76	30	0.07 0.07 0.06 0.06 0.06
Canned BC salmon, 1st quality sockeye	1987: 1.98 1988: 2.06 1989: 2.72 1990: 2.11 1991: 2.00	20.5	0.10 0.10 0.13 0.10 0.10
Fresh shelled pink shrimp	1987: N/A 1988: N/A 1989: 2.38 1990: 2.13 1991: 1.56	24.2	N/A N/A 0.10 0.09 0.06
Whole live lobster > 1 lb	1987: 5.26 1988: 5.17 1989: 5.91 1990: 4.61 1991: 5.17	18.7	0.28 0.28 0.31 0.25 0.28

APPENDIX 2 (Cont'd)

TYPE OF FOOD	COST PRICE PER COOKED PORTION[2] ($/100 g)	PROTEIN CONTENT (g/100g)[3]	COST OF PROTEIN ($/g)
Meat			
Fresh round of beef, Grade A or B, lean and fat	1987: 2.20 1988: 2.16 1989: 2.19 1990: 1.92 1991: 1.85	28.6 (braised)	0.08 0.08 0.08 0.07 0.06
Veal escallop	1987: 2.64 1988: 2.62 1989: 2.79 1990: 2.76 1991: 2.76	26.1	0.10 0.10 0.11 0.11 0.11
Roast pork, boneless, dressed (shoulder)	1987: 1.56 1988: 1.59 1989: 1.34 1990: 1.59 1991: 1.31	27.5	0.06 0.06 0.05 0.06 0.05
Fresh or frozen chicken broiler or fryer, eviscerated, 1-2 kg, Grade A	1987: 0.70 1988: 0.72 1989: 0.85 1990: 0.96 1991: 0.78	31.0	0.02 0.02 0.03 0.03 0.03

APPENDIX 2 (Cont'd)

TYPE OF FOOD	COST PRICE PER COOKED PORTION[2] ($/100 g)	PROTEIN CONTENT (g/100g)[3]	COST OF PROTEIN ($/g)
Other			
Large eggs Grade A	1987: 0.25 1988: 0.26 1989: 0.28 1990: 0.30 1991: 0.28	10.1	0.02 0.02 0.03 0.03 0.03
Cheese (Sliced process cheese)	1987: 0.82 1988: 0.92 1989: 0.94 1990: 0.95 1991: 1.00	19.6	0.04 0.05 0.05 0.05 0.05
Peanut butter	1987: 0.46 1988: 0.46 1989: 0.47 1990: 0.48 1991: 0.59	28.5	0.02 0.02 0.02 0.02 0.02
Baked beans with pork and tomato sauce	1987: 0.32 1988: 0.29 1989: 0.25 1990: 0.30 1991: 0.30	6.1	0.05 0.05 0.04 0.05 0.05

Sources:

(1) Prices in April each year.

(2) Economic Services Division, Quebec Region.

(3) Dubuc and Lahaie, Valeur nutritive des aliments, (Nutritional value of food) 1987.

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D I V I S I O N D E S S E R V I C E S
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